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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/820,864	04/09/2004	Diwakar Garg	06357P USA	8704
23543 7590 12/26/2007 AIR PRODUCTS AND CHEMICALS, INC. PATENT DEPARTMENT 7201 HAMILTON BOULEVARD ALLENTOWN, PA 181951501			EXAMINER CHEN, BRET P	
			ART UNIT 1792	PAPER NUMBER
			MAIL DATE 12/26/2007	DELIVERY MODE PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b>		<b>Applicant(s)</b>	
	10/820,864		GARG ET AL.	
	<b>Examiner</b>		<b>Art Unit</b>	
	B. Chen		1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 10/9/07.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 46-55 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 46-55 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)            | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. _____                                      |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

## DETAILED ACTION

Claims 46-55 are pending in this application. Newly added claims 46-55 and canceled claims 1-45 are noted in the preliminary amendment dated 10/9/07.

### *Specification*

Applicant is reminded of the proper language and format for an abstract of the disclosure.

The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 150 words. It is important that the abstract not exceed 150 words in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means" and "said," should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The language should be clear and concise and should not repeat information given in the title. It should **avoid using phrases which can be implied, such as, "The disclosure concerns," "The disclosure defined by this invention," "The disclosure describes,"** etc.

It is noted that the abstract begins with "A process is described." The examiner suggests deleting the phrase "is described".

Applicant is reminded of the proper content of an abstract of the disclosure.

A patent abstract is a concise statement of the technical disclosure of the patent and should include that which is new in the art to which the invention pertains. If the patent is of a basic nature, the entire technical disclosure may be new in the art, and the abstract should be directed to the entire disclosure. If the patent is in the nature of an improvement in an old apparatus, process, product, or composition, the abstract should include the technical disclosure of the improvement. In certain patents, particularly those for compounds and compositions, wherein the process for making and/or the use thereof are not obvious, the abstract should set forth a process for making and/or use thereof. If the new technical disclosure involves modifications or alternatives, the abstract should mention by way of example the preferred modification or alternative.

The abstract should not refer to purported merits or speculative applications of the invention and should not compare the invention with the prior art.

Where applicable, the abstract should include the following:

- (1) if a machine or apparatus, its organization and operation;
- (2) if an article, its method of making;
- (3) if a chemical compound, its identity and use;
- (4) if a mixture, its ingredients;
- (5) **if a process, the steps.**

Extensive mechanical and design details of apparatus should not be given.

It is noted that the claimed invention is directed to a method. The examiner suggests amending the abstract to reflect same.

The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

It is noted that the claimed invention is directed solely to a method. The examiner suggests amending the title to reflect same.

The disclosure is objected to because of the following informalities listed below.  
Appropriate correction is required.

On p.1 paragraph 1, the lineage should be updated to reflect maturation into a US Patent.

The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

**Claims 46-55 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.**

Dependent claims 47-54 are dependent on canceled claim 42. The examiner will assume that they are dependent on independent claim 46. Appropriate amendments are requested.

In claim 51, it is not clear what the difference is between and appropriate amendments are requested:

- a. Plasma enhanced CVD and plasma assisted CVD
- b. Thermal CVD and chemical assisted CVD.

In claim 51, the phrase "and combinations thereof" is deemed vague and indefinite. How can one combine, for example, thermal CVD and plasma enhanced CVD? The examiner suggests deleting said phrase.

***Claim Rejections - 35 USC § 102-103***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

**Claim 46-47, 51, 54 are rejected under 35 U.S.C. 102(a) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Pyo (6,413,864).**

Pyo discloses a method of manufacturing a copper metal wiring in a semiconductor device in which a diffusion barrier layer 15 is formed by depositing tungsten nitride by a CVD method (col.2 lines 55-53) followed by the deposition of the copper layer by means of MOCVD (col.3 lines 43-50). It is noted that the reference does not teach a (111) preferred orientation nor does it teach a non-stoichiometric amount of nitrogen and thus meets the limitation of the claim. However, the reference fails to specifically teach an organometallic precursor comprising copper.

It is noted that the reference clearly teaches the deposition of copper by MOCVD. One skilled in the art would know, by definition, that one of the precursors has to be organometallic. The skilled artisan would reasonably expect that since the ultimate material to be deposited is copper, that the organometallic precursor is copper and thus reads on the applicant's claim.

Regardless, to utilize a copper organometallic precursor to form the copper would have been obvious to one skilled in the art with the expectation of obtaining similar results.

The limitation of claim 47 appears to be inherent in the Pyo.

The limitations of claims 51 and 54 are taught as noted above.

**Claim 46-47, 51, 54 are rejected under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Morrissey et al. (2002/0053519).**

Morrissey discloses a method of repairing copper seed layers prior to metalization by using an electroplating bath with metal additives (Paragraphs 13-15). The reference teaches the conventionality of using copper films for improved electrical properties and better electromigration but that copper has a tendency to migrate into the dielectric layer (P 4). One way of preventing migration is to utilize a barrier layer such as tungsten nitride (P 4). In one embodiment, chemical vapor deposition can be utilized to form the copper layer using an organometallic precursor (P 5). However, the reference fails to specifically teach an organometallic precursor comprising copper.

It is noted that the reference clearly teaches the deposition of copper by MOCVD. One skilled in the art would know, by definition, that one of the precursors has to be organometallic. The skilled artisan would reasonably expect that since the ultimate material to be deposited is copper, that the organometallic precursor is copper and thus reads on the applicant's claim. Regardless, to utilize a copper organometallic precursor to form the copper would have been obvious to one skilled in the art with the expectation of obtaining similar results.

The limitation of claim 47 appears to be inherent in Morrissey.

The limitations of claims 51 and 54 are taught as noted above.

**Claims 48, 50, 52-53, 55 are rejected under 35 U.S.C. 103(a) as being unpatentable over Morrissey et al. (2002/0053519) or Pyo (6,413,864).**

Pyo discloses a method of manufacturing a copper metal wiring in a semiconductor device in which a diffusion barrier layer 15 is formed by depositing tungsten nitride by a CVD method (col.2 lines 55-53) followed by the deposition of the copper layer by means of MOCVD (col.3 lines 43-50) as noted above. Morrissey discloses a method of repairing copper seed layers prior to metalization by using a barrier layer such as tungsten nitride (P 4) and forming the copper layer by chemical vapor deposition using an organometallic precursor (P 5) as noted above. However, the references remain silent on the type of surface.

It is noted that the reference clearly the successful deposition onto a surface. It appears to be irrelevant whether the surface is amorphous or polycrystalline. Hence, it would have been obvious to one skilled in the art to utilize either an amorphous or polycrystalline surface with the expectation of success in the absence of a showing of criticality.

In claims 52-53, the applicant requires a specific precursor. The reference clearly teaches the use of an organometallic metal precursor as noted above. It would have been obvious to one skilled in the art to utilize the claimed precursor with the expectation of obtaining similar results in the absence of a showing of criticality.

The limitation of claim 55 has been taught above.



**Claim 49 is rejected under 35 U.S.C. 103(a) as being unpatentable over Morrissey et al. (2002/0053519) or Pyo (6,413,864) when either is taken in view of Iacoponi et al. (6,150,268).** Pyo discloses a method of manufacturing a copper metal wiring in a semiconductor device in which a diffusion barrier layer 15 is formed by depositing tungsten nitride by a CVD method (col.2 lines 55-53) followed by the deposition of the copper layer by means of MOCVD (col.3 lines 43-50) as noted above. Morrissey discloses a method of repairing copper seed layers prior to metalization by using a barrier layer such as tungsten nitride (P 4) and forming the copper layer by chemical vapor deposition using an organometallic precursor (P 5) as noted above. However, the references remain silent on a nonstoichiometric composition having more nitrogen.

Iacoponi discloses a using a barrier metal such as tungsten nitride to prevent copper from diffusing into the semiconductor (col.3 lines 26-59). The reference specifically teaches of increasing the nitrogen content to increase its barrier effectiveness but leads to an increase of electrical resistance (col.4 lines 49-67). It would have been obvious to increase the nitrogen concentration of the WN diffusion barrier in the process of Morrissey nor Pyo with the expectation of obtaining the known benefits if one skilled in the art was not concerned with the increase in electrical resistance as taught by Iacoponi.

### ***Double Patenting***

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined

application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

**Claims 46-55 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-21 of copending Application No. 11/738187.** Although the conflicting claims are not identical, they are not patentably distinct from each other because the elimination of a carbide diffusion barrier layer is an obvious variation.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Application/Control Number:  
10/820,864  
Art Unit: 1792

Page 10

Any inquiry concerning this communication or earlier communications from the examiner should be directed to B. Chen whose telephone number is (571) 272-1417. The examiner can normally be reached on 7:30am - 4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Bc  
12/16/07



**BRET CHEN**  
PRIMARY EXAMINER